A VARIABLE SPEED MECHANISM AND METHOD FOR CONTROLLING THE SPEED OF AN ASSOCIATED LAWN MOWING APPARATUS

I. Background Of The Invention

A. Field Of Invention

This invention pertains to the art of methods and apparatuses for use in controlling the ground speed of a lawn mowing apparatuses, and more specifically to methods and apparatuses for use in controlling the ground speed of a walk-behind mower.

B. Description Of The Related Art

It is well known to provide lawn mowing apparatuses, specifically lawn and garden lawn mowing apparatuses such as walk-behind lawn mowers, with apparatuses and methods for controlling their ground speed. One known method uses a spring loaded variable pitch pulley assembly attached to a rotating shaft. The variable pitch pulley assembly typically has two pulley halves forming a "V" shape for a belt connecting the pulley assembly to some type of transmission which is operatively connected to a drive axle. The belt tension is adjusted by any of various means known in the art. When the belt tension is increased, the two pulley halves are forced apart by the belt, allowing the belt to move inwardly toward the shaft. This movement decreases the effective belt diameter of the pulley assembly, supplying a slower speed to the transmission. When the belt tension is decreased, the spring causes the two pulley halves to move closer together, forcing the belt to move outwardly from the shaft. This movement increases the effective belt diameter of the pulley assembly, supplying a faster speed to the transmission.

Another known type is described in U.S. Patent No. 4,117,652 to Jones et al. Jones et al. discloses a belt-driven transmission that is mounted on a deck of a mower

between a pair of wheels. The transmission is driven through a pulley on the engine drive shaft and a pulley on the transmission connected by a belt. The pulley on the transmission includes an upper stationary half affixed to a splined end of a transmission input shaft and a lower half mounted for axial movement on the input shaft. A speed change lever is rotated about the input shaft and includes numerous sloping cam surfaces.

The present invention provides methods and apparatuses for controlling the ground speed of a lawn mowing apparatus using a non-spring loaded variable pitch pulley assembly and a control arm assembly. It is not necessary to adjust the belt tension because the control arm assembly is in contact with one of the pulley halves and it is used to adjust the distance between the two pulley halves. The variable pitch pulley is positioned between the motor and the cutting blade on the primary drive shaft. Thus, unlike Jones et al., the gear (pulley) ratios permit a maximum speed to be provided to the transmission. Also unlike Jones et al., a control arm adjusts the variable pitch pulley assembly using vertical adjustment along the length of the drive shaft. This is considered a significant improvement over the sloping cam surfaces provided by Jones et al.

II. Summary Of The Invention

In accordance with one aspect of the invention there is provided a variable speed mechanism for propelling an associated lawn mowing apparatus which has a body, a transmission which is operatively connected to a drive axle, a shaft, and means for rotating the shaft. The variable speed mechanism has a variable pitch pulley assembly with two pulley halves which is operatively connected to the shaft, a belt connecting the variable pitch pulley assembly to the transmission, a control arm assembly for controlling the distance between the two pulley halves, and means for selectively adjusting the control arm assembly. When the control arm assembly is adjusted, the distance between the two pulley halves is also adjusted. When the pulley halves are

brought closer together the belt is force outwardly, away from the shaft, increasing the effective belt diameter of the pulley assembly. Thus, the belt supplies a faster speed to the transmission. When the pulley halves are brought farther apart, the belt under normal operating tension, is forced inwardly, toward the shaft, decreasing the effective belt diameter of the pulley. In this case, the belt supplies a slower speed to the transmission.

In accordance with another aspect of the present invention, there is provided a control arm assembly for use with a variable speed mechanism. The control arm assembly includes a control arm, a pivot shaft, a pivot bracket and a torsion spring. When the control arm is moved, it pivots around the pivot shaft and adjusts the distance between two pulley halves of a variable pitch pulley assembly.

In accordance with another aspect of the present invention, there is provided a method for selectively controlling the speed of a lawn mowing apparatus. A speed selector is positioned corresponding to the desired lawn mowing apparatus speed. Then tension is applied to a cable which moves the end of a control arm. The control arm adjusts the distance between two pulley halves. As the distances between the two pulley halves changes, so does the effective belt diameter. Once the effective belt diameter has been changed, the speed supplied by the belt to a transmission is correspondingly changed.

The benefits and advantages of the invention will become apparent to those skilled in the art to which it pertains upon a reading and understanding of the following detailed specification.

III. Brief Description Of The Drawings

The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this specification and

illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 shows a typical walk-behind mower using the variable speed mechanism of this invention;

FIGURE 2 is a sectional view of a typical walk-behind mower illustrating the variable speed mechanism of this invention;

FIGURE 3 is an assembly drawing of the cable guide bracket;

FIGURE 4 is an assembly drawing of the control arm assembly;

FIGURE 5 shows the control arm;

FIGURE 6 is an assembly drawing of the variable pitch pulley assembly;

FIGURE 7 is a cross-sectional view taken along the line 1-1 of FIGURE 6 shown with a shaft added;

FIGURE 8 is a cross-sectional view taken along the line 1-1 of FIGURE 6 with a shaft added showing the effective belt diameter when the pulley halves are relatively close together; and,

FIGURE 9 is a cross-sectional view taken along the line 1-1 of FIGURE 6 with a shaft added showing the effective belt diameter when the pulley halves are relatively far apart.

IV. Description Of The Preferred Embodiment

Referring now to the drawings wherein the showings are for purposes of

illustrating a preferred embodiment of the invention only and not for purposes of limiting the same, FIGURE 1 shows a lawn mower 10 which is equipped with the present invention. This embodiment is a typical walk-behind lawn mower but the invention is applicable to riding mowers, off the road lawn mowing apparatuses, and other applications as well.

FIGURE 2 shows a cut-a-way of the lawn mower 10 which has a body 12, a motor 14 or other means for turning a shaft 18, and a cutting blade 19. The lawn mower 10 also has a transmission (not shown) for transmitting power to at least one of the wheels 16 and thereby propel the lawn mower 10. The sectional view shows the variable speed mechanism 20 of this invention. The variable speed mechanism 20 has a speed selector 21, and a cable 22 having first and second ends 23, 25 which runs from the speed selector 21, through a cable guide bracket 24 inside the body 12 to a control arm assembly 30. As seen in FIGURE 2, the first end 23 of the cable is operatively connected to the speed selector 21 and the second end 25 of the cable 22 is operatively connected to the control arm assembly 30. The control arm assembly 30 has a control arm 32 which has a first end 31 attached to the second end 25 of the cable 22 and a second end 33 which is attached to the body 12. The variable speed mechanism 20 also has a variable pitch pulley assembly 40. The variable pitch pulley assembly 40 has a first pulley half 42 and a second pulley half 44. The variable pitch pulley assembly 40 also has a bearing cup 46 which contacts control arm 32. The second pulley half 44 rests on bearing cup 46. A belt (not shown) fits between first pulley half 42 and second pulley half 44 and connects to a transmission (not shown). Finally, an idler is actuated by clutch lever 75 to engage or disengage a belt to propel or stop the mower.

As can be seen in FIGURE 3, the cable guide bracket 24 has a free rolling roller 26 which has a cable channel 28 around its circumference to help guide the cable (not shown). The cable guide bracket 24 is fixedly attached to the body (not shown) with screws 27 but any other acceptable connecting means could be used. As seen in FIGURE 2, the cable guide bracket 24 is positioned substantially above the control arm assembly 30.

With reference to FIGURES 2 and 4-6, the control arm assembly 30 has a control arm 32, a pivot shaft 34, a pivot bracket 36, and torsion spring 38. The control arm 32 has a first end 31 which has a hole 51 for holding the cable 22, an opening 53 into which the shaft and the bearing cup 46 fits, and a second end 33 which attaches to the body 12. The second end 33 of the control arm 32 has connecting members 35 which hold the pivot shaft 34. The pivot shaft 34 also fits into openings 37 in the pivot bracket 36 which connects the control arm 32 to the body (not shown). Torsion spring 38, having a first end 55 and a second end 57, fits around pivot shaft 34. The first end 55 of the torsion spring 38 fits against the second end 33 of the control arm 32. The second end 57 of the torsion spring 38 fits against the pivot bracket 36. With this arrangement, the torsion spring 38 biases the control arm 32 such that the first end 31 of the control arm 32 puts tension on the cable 22. With reference now to FIGURE 5, the control arm 32 also has first 61 and second 63 sides which are in contact with a bearing cup (not shown here but discussed below). The first and second sides, 61 and 63, have contoured surfaces, 62 and 64, which permit even wear as the bearing cup moves across first and second sides 61 and 63.

FIGURES 5-7 show the variable pitch pulley assembly 40 which has first 42 and second 44 pulley halves. As can be seen, the variable pitch pulley assembly 40 is operatively associated with the shaft 18. The second pulley half 44 can be moved along the length of shaft 18. The variable pitch pulley assembly 40 also has a bearing cup 46 which holds bearing 48. The bearing cup 46 has a first hook 45 and a second hook 47 for hooking the bearing cup 46 to the control arm 32. The first and second hooks 45, 47 fit on the contoured surfaces 62, 64 shown in FIGURE 5, of the first and second sides 61, 63 respectively of the [control arm 30] control arm 32.

With reference now to FIGURES 8-9, movement of the bearing cup 46 along the shaft 18 also moves the second pulley half 44 and thus the effective diameter of the belt 17 is changed. FIGURE 8 shows the variable pitch pulley assembly 40 where the distance between the first pulley half 42 and the second pulley half 44 is X1. The belt

17, which fits within the "V" shape 41, is thus positioned at an effective diameter D1. FIGURE 9 shows the variable pitch pulley assembly 40 where now the distance between the first pulley half 42 and the second pulley half 44 is X2. Note that the distance X2 is greater than the distance X1 and that "V" shape 49 is larger that "V" shape 41. The effective diameter D2 is, correspondingly, smaller than effective diameter D1. The larger the effective diameter of the variable pitch pulley assembly 40, the greater the speed which the belt 17 supplies to the transmission (not shown). Thus, the arrangement shown in FIGURE 8 would provide greater speed than the arrangement shown in FIGURE 9.

In the operation of the variable speed mechanism, with reference to FIGURE 2, the speed selector 21 is positioned corresponding to the desired lawn mowing apparatus ground speed. Positioning the speed selector 21 creates tension in the cable 22 which correspondingly moves the first end 31 of the control arm 32. When the control arm 32 is moved, it rotates about the pivot shaft (shown in FIGURE 4) adjusting the position of the bearing cup 46 which, in turn, adjusts the position of the second pulley half 44 along the shaft 18. Once the second pulley half 44 has been positioned, the effective belt diameter is set. If the effective belt diameter is increased, the speed supplied to the transmission is increased. If the effective belt diameter is decreased, the speed supplied to the transmission is decreased.

The preferred embodiments have described, hereinabove. It will be apparent to those skilled in the art that the above methods may incorporate changes and modifications without departing from the general scope of this invention. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, it is now claimed: